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Research Article

Yield and Yield Characteristics of Selected Grain Maize Varieties Grown as a Main Crop in the Amik Plain

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ABSTRACT

This study was conducted to determine the yield and yield components of selected grain maize varieties under main crop conditions in the Amik Plain. Six widely preferred maize varieties in the region (AGM 1506, AGM 6819, P1541, P1551, P1884, and P2105) were used as experimental materials. The trial was established in 2023 using a randomized complete block design with three replications. In order to evaluate yield and yield characteristics, plant height (BB), stem diameter (SÇ), leaf ratio (YO), stem ratio (SO), cob ratio (KO), thousand-kernel weight (BTA), hectoliter weight (HA), grain yield (SY), and harvest index (Hİ) were examined. Among the assessed characteristics, BB, SO, BTA, HA, TV, and Hİ were significantly influenced by variety differences ($P < 0.05$), while SÇ, YO, and KO were not affected. Principal component analysis revealed that each variety exhibited distinct results across nearly all measured traits. Overall, AGM 6919 demonstrated superior performance in terms of yield. To provide a conclusive recommendation, a second year of similar experimentation is needed.

Keywords: Maize, variety, yield, seed, main crop.

1. INTRODUCTION

Dent maize is widely used not only for food and feed but also across various industrial sectors. In Türkiye, dent maize is cultivated primarily for feed, starch, glucose, oil, and bioethanol production, with major growing areas located in the Mediterranean, Central Anatolia, and Southeastern Anatolia regions. In 2023, approximately 9.5 million decares of land were allocated to dent maize cultivation in Turkey, yielding an estimated 9 million tons of production.[1] Compared to other cultivated crops, maize farming is generally more compatible with mechanized agriculture. Additionally, due to its resilience to pests, diseases, and weeds, as well as its suitability for cultivation as both a primary and secondary crop, particularly in regions with temperate climates, maize has become increasingly preferred by growers.[2] However, selecting a variety adapted to regional and climatic conditions remains a crucial factor in successful maize cultivation.

To achieve optimal yields from dent maize, it is essential to implement timely and adequate management practices and to select varieties best suited to specific climate and soil requirements.[3] In Turkey, there are over 350 registered maize varieties authorized for production, yet their performance may vary significantly across different regions. Thus, investigating the yield potential and characteristics of varieties commonly chosen by farmers in various areas and identifying those that demonstrate superior performance are critical.[4]

This study evaluates the yield performance of several maize varieties commonly preferred by farmers in the Hatay Amik Plain for grain production.

2. MATERIALS AND METHODS

In this study, the maize varieties AGM 1506 (FAO 700), AGM 6819 (FAO 700), P1541 (FAO 550), P1551 (FAO 630), P1884 (FAO 700), and P2105 (FAO 700) were selected as plant materials. The experiment was conducted in a randomized complete block design with three replications, established at the Agricultural Research and Application Center's Selam Farm of Hatay Mustafa Kemal University (36°12ˈN, 36°25ˈE). Each plot consisted of four rows, with rows spaced 70 cm apart

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and plants within rows spaced at 18 cm. The individual plot width was set to 2.8 m, with a row length of 5 m. The maize varieties were randomly assigned to each block to represent different replications. Sowing (8400 plant m^{-2}) took place on April 20, 2023, and harvesting was carried out on August 10, 2023. Based on soil analysis, 20 kg N, 8 kg P_2O_5, and 8 kg K_2O per decare were applied. A base fertilizer (15-15-15) was used initially, and additional nitrogen was supplied as urea when plants reached 40–50 cm in height. Soil analysis revealed a clay-loam texture, low organic matter content (1.5%), moderate lime level (6.5%), and a slightly alkaline pH (7.6). The P_2O_5 content of the soil was found to be low (2.2%), and no salinity issues were detected.

Table 1. Climate data from the nearest meteorological station to the study area and seasonal norms

Months	2023 Total Precipitation (mm))	Seasonal Norms (1991-2020) Total Precipitation (mm)	2023 Average Temperature (°C)	Seasonal Norms (1991-2020) Average Temperature (°C)
April	8	108.4	17.7	17.4
May	0	89.8	24.1	21.6
June	0	20.3	27.3	25.1
July	0	8.1	30.9	27.6
August	0	5.4	31.5	28.3

Weed control was managed manually, and five irrigations were applied at 20-day intervals, with the first following the earthing-up process. Meteorological data obtained from the nearest weather station are presented in Table 1. According to the data, rainfall occurred only in April during the growing season, resulting in an exceptionally dry vegetative period. Furthermore, temperatures showed a continuous increase from April to August, with averages higher than seasonal norms.
For yield and yield components, the following characteristics were assessed:

Plant Height (cm): Measured from the soil surface to the apex of the plant on 20 samples using a tape measure.

Stem Diameter (mm): Measured at the midpoint between the first and second nodes on 20 plants using a digital caliper.

Leaf, Stem, and Cob Ratios (%): Separated components from 20 plants were weighed individually and calculated as percentages of the total plant biomass.

Thousand-Kernel Weight (g): Seeds from each variety were homogenized, counted in sets of 100 seeds across four replicates, weighed, and converted to a thousand-kernel weight.

Hectoliter Weight (kg hl^{-1}): Measured by filling a 250 mL cylinder with seeds, then calculating the hectoliter weight.

Grain Yield (kg da^{-1}): Cobs harvested from the central rows of each plot were threshed, weighed, and converted to yield per decare.

Harvest Index: Calculated as the ratio of grain weight to total plant biomass at harvest, using the formula:
Harvest Index=(Grain Weight/Plant Biomass)×100
All data were analyzed using JMP 13.0 statistical software for variance analysis, with significant results further grouped using Tukey's HSD test. Additionally, correlation analysis was conducted to examine relationships among traits, and principal component analysis was applied to assess the yield performance of maize varieties across the evaluated parameters.

3. RESULTS AND DISCUSSION

The data on plant height, stem diameter, leaf ratio, stem ratio, and cob ratio are presented in Table 2. While significant differences were observed among maize varieties in terms of plant height and stem ratio, the other traits did not show notable variation (Table 2). Excluding AGM 1506, which showed the shortest plant height, the remaining maize varieties exhibited similar plant height results. The varieties AGM 6919, P1541, P1551, P1884, and P2105 demonstrated comparable heights. This is consistent with Ci et al.[5] who reported that plant heights varied among maize varieties in China, noting that some maize cultivars may exhibit similar plant heights while others may differ significantly.[6] The plant height results obtained in this study similarly showed variations across some cultivars.

Table 2. Vegetative trait values of selected maize varieties

Varieties	Plant Height (cm)	Stem Thickness (mm)	Leaf Ratio (%)	Stem Ratio (%)	Cob Ratio (%)
AGM 1506	201.40±2.99^b	18.22±0.49	23.50±1.53	18.00±0.94^b	58.50±2.09
AGM 6919	219.42±2.50^a	20.66±1.43	21.73±0.77	26.71±0.79^{ab}	51.56±1.27
P1541	233.73±7.31^a	17.43±0.14	19.19±0.45	30.31±3.23^a	50.49±2.82
P1551	232.20±2.05^a	20.63±1.19	22.29±1.39	16.66±0.37^b	61.06±1.75
P1884	219.53±1.60^a	20.17±1.06	22.08±1.42	18.45±2.14^b	59.46±3.54
P2105	231.93±3.14^a	17.41±0.94	23.90±1.90	19.02±3.33^{ab}	57.09±4.84
P-value	0.0005	0.1387	0.2001	0.0100	0.1853
CV (%)	2.52	7.75	9.54	14.48	8.35

*P-value: Probability values, CV: Coefficient of variation.
Values in the same column with different letters are significantly different.

Examining the stem ratio data (Table 2), P1541 demonstrated the highest stem ratio, although AGM 6919 and P2105 also exhibited similar values. Han et al.[7] observed no significant changes in stem weight among some maize varieties, yielding comparable results. In contrast, another study reported variations in stem ratios across maize varieties[8], and the findings in this study align with Güneş and Öner's[8] observations.

The values for thousand-kernel weight, hectoliter weight, grain yield, and harvest index are summarized in Table 3.

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Analysis of Table 3 reveals that all characteristics were significantly influenced by the maize varieties. Thousand-kernel weight ranged from 197.60 g to 290.00 g, with AGM 6919 exhibiting the highest weight, while P1541 and P1551 yielded similar results. AGM 1506 recorded the lowest thousand-kernel weight. Studies by Kılınç et al.[9] found thousand-kernel weights between 294.2 g and 370.8 g in certain maize varieties, while another study identified values ranging from 184.60 g to 249.04 g. Variability in thousand-kernel weight across studies may stem from differing genetic characteristics and growing conditions.

Table 3. Yield and yield component values of selected maize varieties

Varieties	Thousand Grain Weight (g)	Hectoliter Weight (kg hl⁻¹)	Grain Yield (kg da⁻¹)	Harvest Index (%)
AGM 1506	197.60±5.03^{c}	72.00±1.22^{ab}	846.22±68.11^{b}	47.28±2.97^{ab}
AGM 6919	290.00±13.47^{a}	68.53±1.75^{b}	1140.72±61.28^{a}	39.16±2.26^{b}
P1541	276.90±8.60^{ab}	70.67±2.93^{ab}	988.71±47.01^{ab}	40.45±1.79^{ab}
P1551	258.76±12.27^{ab}	74.67±1.16^{ab}	955.73±47.27^{ab}	46.27±1.05^{ab}
P1884	232.78±6.21^{bc}	76.27±0.27^{a}	895.38±24.82^{ab}	49.52±2.12^{a}
P2105	207.42±16.71^{c}	73.07±0.71^{ab}	810.13±80.47^{b}	41.10±1.36^{ab}
P-value	0.0004	0.0365	0.0180	0.0273
CV (%)	7.44	3.25	10.34	7.61

***P-value**: Probability values, **CV**: Coefficient of variation.
Values in the same column with different letters are significantly different.

The hectoliter weight ranged from 68.53 kg hl^{-1} to 76.27 kg hl^{-1}, with P1884 recording the highest and AGM 6919 the lowest. Other varieties displayed similar weights to P1884 and AGM 6919. Vartanlı et al.[10] recorded hectoliter weights between 65.43 kg hl^{-1} and 73.53 kg hl^{-1} under Ankara conditions, while Kılınç et al.[9] observed values ranging from 79.10 kg hl^{-1} to 84.00 kg hl^{-1} in Diyarbakır, aligning closely with our findings. Grain yield varied from 810.13 kg da^{-1} to 1140 kg da^{-1}, with AGM 6919 achieving the highest yield, followed by similar results for P1541, P1551, and P1884. P2105 yielded the lowest grain output. Previous studies reported higher yields of 1577 kg da^{-1} to 1903 kg da^{-1}[10] and 1232 kg da^{-1} to 1518 kg da^{-1}[9] under different conditions, likely due to genetic and ecological variations.

Harvest index values ranged from 39.16% to 49.52%, with P1884 recording the highest and AGM 6919 the lowest index. Akgün and Dokuyucu[11] similarly found that harvest index values varied across maize varieties under primary production conditions, ranging from 40.6% to 50.9%. Under secondary crop conditions, however, Akgün et al.[12] reported lower values (23.5% to 33.2%) for the same varieties. Numerous studies have demonstrated that both genetic factors and cultivation conditions influence harvest index results. [13,14,15]

Correlation analysis results for the traits assessed in maize varieties are shown in Table 4. Plant height showed negative correlations with stem diameter (SÇ), leaf ratio (YO), cob ratio (KO), and harvest index (Hİ), while it was positively correlated with stem ratio (SO), thousand-kernel weight (BTA), hectoliter weight (HA), and grain yield (TV). The positive relationship between plant height and grain yield has also been confirmed by Salami et al.[16]. Other studies, however, have reported varying correlations among these traits across maize varieties[17,18,19,20], likely due to differences in regional and genetic characteristics.

Table 4. Correlation analysis results of examined traits

	BB	SÇ	YO	SO	KO	BTA	HA	TV
SÇ	-0.11							
YO	-0.13	-0.14						
SO	0.11	-0.06	-0.27					
KO	-0.06	0.12	-0.14	-0.91				
BTA	0.35	0.27	-0.34	0.64	-0.51			
HA	0.24	0.12	0.24	-0.64	0.55	-0.34		
TV	0.10	0.19	-0.15	0.48	-0.43	0.83	-0.48	
Hİ	-0.34	0.10	0.36	-0.46	0.33	-0.30	0.44	-0.09

***BB**: Plant height, **SÇ**: Stem thickness, **YO**: Leaf ratio, **SO**: Stem ratio, **KO**: Cob ratio, **BTA**: Thousand grain weight, **HA**: Hectoliter weight, **TV**: Grain yield, **Hİ**: Harvest index
Positive values at row-column intersections represent positive correlations, while negative values indicate negative correlations.

The principal component biplot analysis illustrating the relationships among traits and maize varieties is shown in Figure 1. This analysis more clearly demonstrates which varieties are superior for specific traits.[21,22] The mean values for all traits across varieties are explained by principal component 1 (F1) at 57.56% and principal component 2 (F2) at 20.14%, totaling 77.70%. AGM 6919 was prominent in terms of grain yield and thousand-kernel weight, while P1541 excelled in stem ratio. P1884 and P1541 varieties were superior in terms of stem diameter, harvest index, hectoliter weight, and cob ratio. Overall, the principal component analysis indicated distinct results for each variety across traits, with AGM 6919 being the most productive. Previous studies using principal component analysis have also found that varieties respond differently across measured traits.[21,23,24]

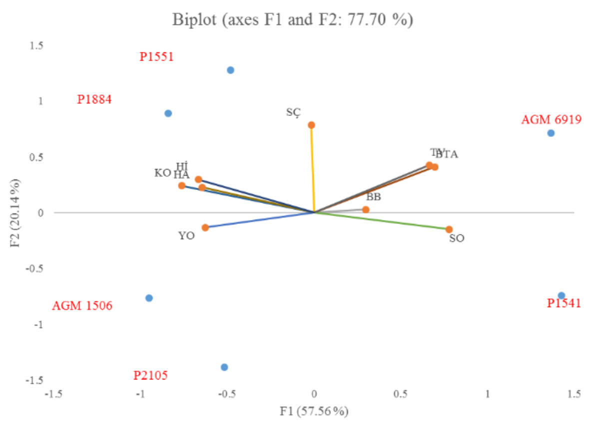

Figure 1. Relationships between investigated traits and corn variety according to principal component biplot analysis

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4. CONCLUSION

In this study, the yield and yield-related traits of selected hybrid maize varieties under main crop conditions in the Amik plain. The results revealed significant differences among the maize varieties in each trait examined. Notably, AGM 6919 emerged as the superior variety, particularly in terms of seed yield and thousand-kernel weight. However, to make a more robust recommendation for the region, it is necessary to repeat this study in a second year for confirmation and consistency of findings.

Conflict of Interest

I declare that there is no conflict of interest with any person, institute, company, etc.

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